HT MEDICAL, INC.

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March 3, 1997

LCDR Paul L. Knechtges
Naval Medical Research & Development Command
National Naval Medical Center
901 Wisconsin Avenue
Building 1, T-11
Bethesda, MD 20889-5606

Re: Technical Report: Contract: N0014-95-C-0098
Virtual Environment Training for Trauma Management

Dear LCDR Knechtges:

Enclosed, you will find the second quarterly Technical Report, due under the above referenced contract.

Upon your review of this report, do not hesitate to contact me if you should have any questions.

Sincerely,

Greg Merril

Gregory L. Merril
President & CEO

cc: Anna M. Weston, Contracting Officer (transmittal Letter only)
Director, Naval Research Laboratory (1 copy)
Defense Technical Information Center (2 copies)

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March 1, 1997

LCDR Paul L. Knechtges
NMRDC
Bldg 1, 11th Deck, NNMC
Bethesda, MD 20889-56056

Dear LCDR Knechtges:

This report summarizes the quarterly status of our Phase II SBIR research (contract N00014-95-C-0098) in the development of Virtual Environment Training for Trauma Management. This report covers the period from November 1996 through January 1997.

Catheter Navigation

Enhancements to the techniques for simulated central line navigation have been a core technical focus. Representations of the physical characteristics of the catheter and methods for modeling the anatomy have presented challenges.

A Finite Element Modeling technique has been applied to simulate the catheter and we are currently in the process of debugging this code. Some limitations have been shown with this technique and additional development with hybrid modeling algorithms are being explored. A voxel-based collision model for the venous anatomy is being developed. The base concept appears to be working well, although it needs to be tested with the central line/catheter model to see if the behavior will indeed be satisfactory.

Real-time Interactive Medical Simulator Architecture

A variety of Object Oriented Analysis and Design tools were researched as candidates to provide the basis of a team-oriented approach to real-time interactive medical simulator design. Candidates included Graphical Designer, Object Team, and ObjecTime. In addition, HT did an extensive research effort into what it would take to develop our own tool set in-house. The requirements for the tool set include:

1) Compatibility with Silicon Graphics workstations
2) Production of compilable code
3) Support for team development (multiple users)
4) Support for multiple processes/processors,
5) Support for hard real-time development

An evaluation methodology was developed that included a test specification for a distributed interactive example problem. Each tool was evaluated for it's ability to efficiently implement the computation- and graphics-intensive program using OpenGL, and to provide a clear, useable design. Preliminary tests were performed by the software vendors themselves. Only of the tools, Object Team and ObjecTime were able to produce code that resulted in a useable version of the application. Only Object Team was able to produce code that ran on multiple CPUs effectively. Based on these results, a further investigation of the capabilities and limitations of the ObjecTime development environment was undertaken. In the last week in January, two engineers spent a week at the

ObjecTime offices working with their engineers to develop methods for incorporating OpenGL effectively. A final decision on the development environment will be made in February.

Graphical User Interface Development
During this period work was begun on the development of a set of user interface class libraries using the capabilities of the Java language to optimize efficiency in integrating cognitive and motor skill training. The libraries are intended to allow the rapid development of training material, such as selection of training scenarios, review of case history files, selection of tools, and collection and analysis of student activities, scores, and overall performance. Java was chosen because it provides an excellent basis for rapid development. It also provides the benefits of code reuse that are inherent in object-oriented development, while avoiding many of the complexities inherent in other languages. More importantly, the language is platform-independent, greatly facilitating migration of educational modules across hardware and software platforms if/when required, and enabling the development of training software that can run on platforms from medium to high performance and cost.

Currently, we have completed the development of classes for the following:

- Patient History review/evaluation: allow the user to follow a cognitive series of steps at the beginning of a training simulation. The "folder" paradigm is employed to give the user a familiar, yet simple, way of navigating the potentially large quantities of patient information.

- Selection Panel: a set of classes that simplify development of to provide for a variety of tool and technique selection scenarios.

- Image viewers: a variety of image viewers such as scaleable, scrolled, and "dragable" viewers allow the user to manipulate a great range of image sizes from small to much larger than the viewable area.

Hardware Evaluation
Silicon Graphics introduced their new system, the Octane. This is a dual processor system - "sort of an Impact on steroids." Using this system, plus an embedded controller on the interface device, is currently the platform of choice for the completed simulation system - real-time graphics and simulation on one box, at a reasonable cost. We anticipate getting an evaluation system within the next quarter so that we can evaluate its applicability in more detail.

Content
We acquired and have abstracted content from FDA videotapes on clinical complications related to central line placement.

Please do not hesitate to contact me if you require further information.

Sincerely,

Gregory L. Merril
President & CEO